

**SESSION XXIII**  
**ENVIRONMENTAL PREFERRED SUBSTITUTIONS**

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## **Pollution Prevention: Identification of Environmentally Preferable Paints**

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Demonstrating environmental leadership, Aberdeen Proving Ground (APG) identified environmentally preferable paints from among some 1,300 products used on the installation. This was an essential step in fulfilling the Army's mandate to purchase environmentally preferable products under Executive Order 12873 and Federal Acquisition Regulations, Part 23.

### **Approach**

APG contracted with Green Seal, a nonprofit testing and rating service, to identify environmentally preferable paint standards. The ingredients identified in the material safety data sheet (MSDS) for paints currently in use at APG were evaluated against these new APG environmental standards for paint. All paints tested were already in compliance with current federal and state regulatory standards. Paints that met the APG standards (i.e., contained no prohibited compounds) were then tested for volatile organic compounds (VOCs) by Aberdeen Test Center. The center used U.S. Environmental Protection Agency (EPA) Reference Test Method 24, Determination on Volatile Matter Content, Water Content, Density Volume Solids, and Weight Solids of Surface Coatings, CFR Title 40, Part 60 Appendix A. A list of paints that met the standards and passed VOC tests was distributed to APG purchasers as an example of paints that minimize adverse effects on the environment.

### **Background**

#### **Volatile Organic Compound Restrictions**

Volatile organic compounds (VOCs) are organic compounds with a vapor pressure greater than 0.1 millimeter of mercury at 25 °C, as determined by ASTM D3960, Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings. Compounds excluded from

this definition are methane, carbon monoxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate.

All oil-based paints and most water-based paints contain organic solvents that disperse and carry the other paint components and accelerate drying of the applied paint. Traditional oil-based formulas contain 40% to 60% organic solvents while water-based paints contain 5% to 10% organic solvents. These solvents contain VOCs that have been identified as significant contributors to the formation of ground-level ozone and photochemical smog. Unlike the stratospheric ozone protecting the earth from harmful radiation, excessive ground-level ozone is harmful to plant and animal life.

Ground-level ozone is produced when its precursors, VOCs and nitrogen oxides (NO<sub>x</sub>), combine in the presence of sunlight. While architectural coatings in total contribute less than 2% of the more than 25 million tons of VOCs annually released in the United States, their concentrated use in urban areas significantly contributes to ground-level ozone formation and exacerbates health problems due to degraded air quality.

Due to the documented health risks associated with high VOC levels, APG has set stringent standards (table 1).

**Table 1. APG VOC Limits for Paints**

Type of Paint	VOCs (grams/liter)	VOCs (pounds/gallon)
Interior architectural		
Flat	50 g/l	0.42 lb/gal
Non-Flat	150 g/l	1.25 lb/gal
Exterior architectural		
Flat	100 g/l	0.83 lb/gal
Non-Flat	200 g/l	1.66 lb/gal
Anticorrosive		
Flat	250 g/l	2.1 lb/gal
Semi-Gloss	250 g/l	2.1 lb/gal
Gloss	250 g/l	2.1 lb/gal

### **Inorganic Component Restrictions**

Paints often contain inorganic and organo-metallic components used as preservatives, additives, and pigments. Table 2 lists the base inorganic components prohibited by APG standards.

**Table 2. Inorganic Components Prohibited by APG Standards for Paints**

Antimony
Cadmium
Hexavalent chromium
Lead
Mercury

Though lead was once commonly used in several components in paint, its use in recent years has been curtailed. The highly toxic nature of lead and its historically pervasive use in plumbing fixtures, solders, gasoline additives, and paint has contributed to establishing lead poisoning as the number one neurotoxic disease in this country. While the intentional use of lead has been phased out, its presence is still allowed up to 0.06% for surface architectural coatings (16 CFR Part 1303).

Lead and mercury attack the central nervous system (CNS) and cause CNS depression as well as severe damage to the liver and kidneys. Lead is especially known for its severe toxic effects on children. Mercury has variable effects on the brain, including personality changes, tremors, and vision, hearing, and memory problems. Short-term exposure is often associated with damaged lungs, nausea, vomiting, diarrhea, increased blood pressure, and dermal and eye irritation.

### Proscribed Organic Compounds Found in APG MSDSs

Organic chemical compounds in paint affect a number of paint characteristics from how smoothly the paint flows to its freeze resistance. Table 3 lists all compounds prohibited by APG standards.

**Table 3. Organic Compounds Prohibited by APG Standards for Paints**

Methylene chloride	Di-n-butyl phthalate
1,1,1-trichloroethane	Di-n-octyl phthalate
Benzene	Diethyl phthalate
Toluene (methylbenzene)	Dimethyl phthalate
Ethylbenzene	Isophorone
Vinyl chloride	Formaldehyde
Naphthalene	Methyl ethyl ketone
1,2-dichlorobenzene	Methyl isobutyl ketone
Di (2-ethylhexyl) phthalate	Acrolein
Butyl benzyl phthalate	Acrylonitrile

These compounds pose widespread environmental and health concerns and many are on the high-priority list for EPA's 33/50 program. Paints containing the chemicals discussed below are not considered environmentally acceptable under the APG standard.

Methyl ethyl ketone (MEK) (2-butanone) is restricted because of its environmental and health effects. MEK causes CNS depression as well as upper respiratory tract irritation, nausea, dizziness, and headaches. MEK can also damage the liver and kidneys, and its photochemical reactivity makes it a dangerous precursor to smog.

Benzene usually enters the atmosphere from emissions and exhaust associated with gasoline use or production. Benzene is a known human carcinogen. It also has an accelerated photochemical reaction when in the presence of typical atmospheric pollutants such as nitrogen oxides and sulfur dioxide.

Di-2-ethylhexyl-phthalate (DEHP) is considered slightly to moderately toxic, causing CNS depression as well as dermal, respiratory, gastrointestinal, and esophageal irritation.

Dibutyl phthalate (DBP), considered toxic by all routes (dermal, ingestion, and inhalation), reacts photochemically in the atmosphere and degrades to hydroxyl radicals.

Toluene severely effects the brain. Long-term exposure can cause problems with speech, vision, hearing, muscle control, memory, balance, and general mental ability. Toluene also effects the kidneys, liver, and CNS in test animals. At this time EPA has not classified toluene by its carcinogenicity; however, they have placed it on their list of priority pollutants.

### Findings

Thirty-six of the 178 paints evaluated met APG standards (i.e., they contained no prohibited compounds). Of the 36, 31 were available to be tested for volatile organic compounds (VOCs). Review statistics are shown in table 4.

**Table 4. Statistics for Reviewed Paints**

Element	Quantity
MSDSs examined	130
Paints evaluated	178
Paints eliminated by ingredients and/or VOCs	126
Paints "out of business" or "no longer made"	16
Paints qualified for VOC testing from MSDSs	36
Paints qualified for VOC testing but unavailable	5
Paints tested for VOC levels	31

Twenty-four paints in a variety of finishes were found environmentally acceptable under APG standards. None of the anticorrosive paints tested had acceptable VOC levels. While the federal government neither endorses nor recommends any specific brands of paint, tables 5 and 6 list the results for those paints in use at APG that tested environmentally acceptable. There may be additional paints, not in use at APG, that would also meet the APG standard.

**Table 5. Examples of Environmentally Acceptable Interior Architectural Paints**

APG ID	Manufacturer	Product Code	Paint Name	Stated VOCs	Tested VOCs
<b>Flat - APG standard - 50 g/l</b>					
60221	Benjamin Moore	212	Pristine FLAT	26 g/l	12 g/l
60269	Duron	7420226	Texture Paint FLAT	27 g/l	14 g/l
	Sherwin-Williams		Style Perfect FLAT	47 g/l	49 g/l
62136	Benjamin Moore	258	Moore's Ceiling White FLAT	37 g/l	51 g/l
<b>Semi-gloss - APG standard - 150 g/l</b>					
60220	Benjamin Moore	213	Pristine EGG	23 g/l	16 g/l
61940, 60226, 60206	Benjamin Moore	214	Pristine SG	18 g/l	20 g/l
72519	Sherwin-Williams		ProMar 700 SG	62 g/l	52 g/l
35375	Benjamin Moore	215	Regal SATIN	50 g/l	68 g/l
37644.01	Sherwin-Williams		Style Perfect SG	103 g/l	76 g/l
60210	Benjamin Moore	322	Moore Kitchen & Bath SATIN	74 g/l	81 g/l
60398.31	Sherwin-Williams		ProMar 200 SG	142 g/l	86 g/l
60398	Sherwin-Williams		ProMar 400 SG	103 g/l	99 g/l
60270	Duron	53 Line	Pro Kote SG	137 g/l	112 g/l
37645.01	Sherwin-Williams		Style Perfect SATIN	119 g/l	125 g/l
<b>Gloss - APG standard - 150 g/l</b>					
57382	Duron	25 Line	Deluxe GLOSS	126 g/l	117 g/l

**Table 6. Examples of Environmentally Acceptable Exterior Architectural Paints**

APG ID	Manufacturer	Product Code	Paint Name	Stated VOCs	Tested VOCs
<b>Flat - APG standard - 100 g/l</b>					
59528	Benjamin Moore	171	Moorcraft FLAT	35 g/l	80 g/l
74215	Benjamin Moore	023	Fresh Start Ext. Primer	31 g/l	92 g/l
<b>Semi-gloss - APG standard - 200 g/l</b>					
59512	Benjamin Moore	170	Moorcraft SATIN	214 g/l	111 g/l
55143.12	Sherwin-Williams		Super Paint SATIN	108 g/l	129 g/l
15633.24	Sherwin-Williams		A-100 EXT SATIN	133 g/l	158 g/l
73404	Benjamin Moore	122	Moore EXT Floor & Patio	155 g/l	176 g/l
50884	Benjamin Moore	096	Moorglo House and Trim EXT NF	210 g/l	191 g/l
71954	Duron		Weathershield SG	173 g/l	203 g/l
<b>Gloss - APG standard - 200 g/l</b>					
15633.37	Sherwin-Williams		A-100 GLOSS	155 g/l	107 g/l

Information provided by manufacturers in the MSDSs varied in substance and form. VOC test results differed by as much as three times that stated. VOC levels were lower than the manufacturer's stated value for 42% of the paints and higher than the manufacturer's value for 58% of the paints.

Ninety-four paints, 53% of the total evaluated, failed the VOC tests. Fifteen paints, nearly 10%, contained a lead compound, which is prohibited for its known toxicological effects on humans. Seventeen paints were rejected because of the presence of one or more prohibited organic chemical components. For example, 10 contained methyl ethyl ketone (MEK), 9 contained toluene, and 4 contained ethyl benzene.

### **Conclusions**

An assortment of environmentally acceptable paints, in a variety of finishes, are in use at APG. The paints are manufactured by three sources, providing opportunity for competitive procurement. There may be additional paints that were not tested because they were not in use at APG, which never the less meet the APG standard. Restricting purchases to those that meet the environmentally preferable paint standards will enable APG to meet its mandate to minimize the effect of paints on the environment.

Based on the conclusions, APG expects to use the final standards as the basis for all procurements. APG will circulate its paint standard to all units and tenants and ask buyers to adhere to them while, at the same time, reminding them of proper paint disposal measures.